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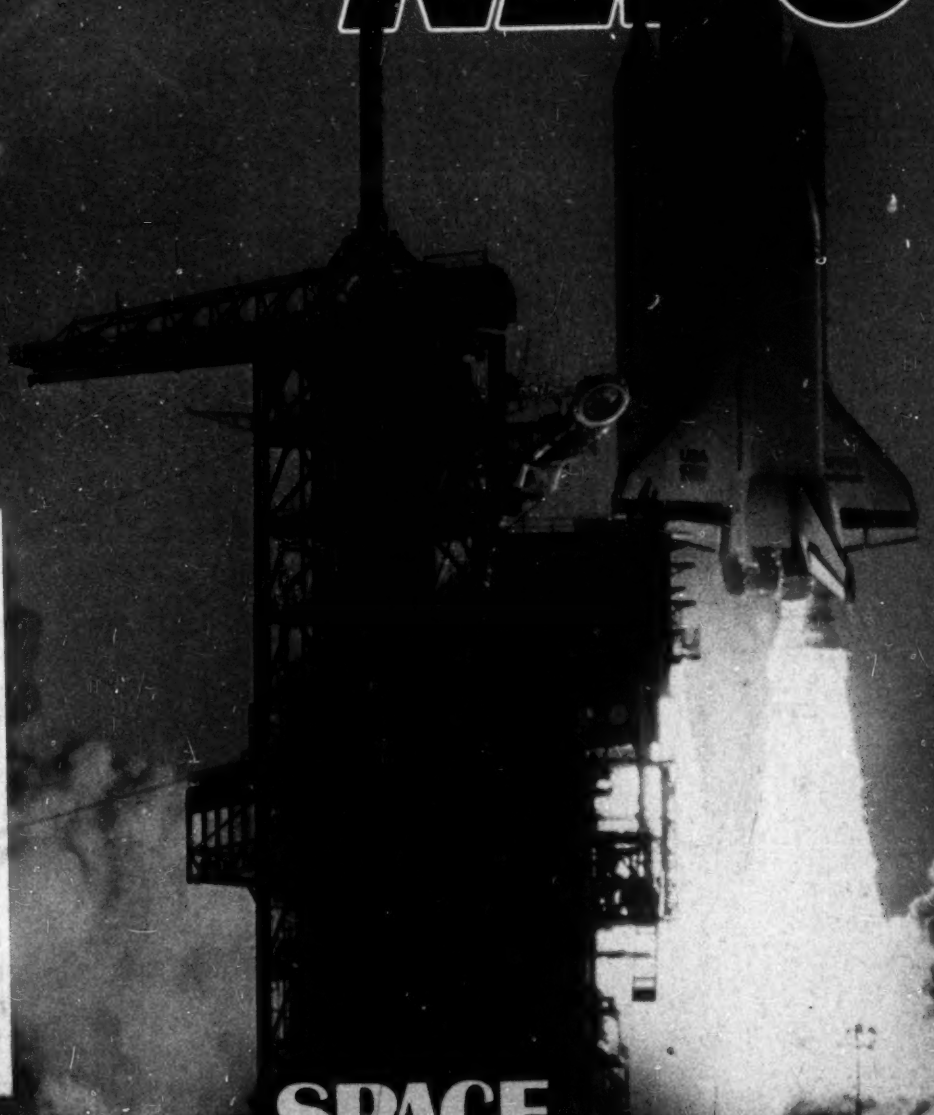
JUNE 23, 1986

CHEMICAL & ENGINEERING

NEWS



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SPACE SHUTTLE

Panel blames accident on faulty joint, mismanagement
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CHEMICAL & ENGINEERING
NEWS

Volume 64, Number 25
CENEAR 64 (25) 1–98
ISSN 0009-2347

JUNE 23, 1986

News of the Week

■ **EPA Administrator Thomas must grapple with some tough problems—Superfund phasedown, RCRA, and ozone regulation.** **Page 6**

■ **Supreme Court rules FDA need not set regulations on hazardous substances that unavoidably get into food.** **Page 7**

■ **Henley Group forms medical and scientific technologies firm centered on Fisher Scientific.** **Page 7**

■ **OSHA's new rules lower amount of asbestos that can be present in the workplace.** **Page 7**

■ **NSF funds two new laboratories for ultralow-temperature research.** **Page 8**

■ **Beckman Institute, for research on problems at the chemistry/biology interface, to be established at Caltech.** **Page 8**

Cover: Launch of space shuttle *Challenger* from Kennedy Space Center three years ago. Photo courtesy of NASA

International Business

BP Chemicals is striving to be a leading supplier of polyethylene in Western Europe; Bhopal has brought new legislation, change in operating practices for India's chemical industry. **Page 19**

Government

EPA needs more time, more money to re-evaluate pesticides now on the market, General Accounting Office reports. **Page 24**

Parsons Award

Norman Hackerman, retired from the presidency of Rice University, is the recipient of ACS's Charles Lathrop Parsons Award. **Page 26**

Science

Quasicrystalline metal alloys seem to have both ordered structure and fivefold symmetry, research indicates. **Page 35**

Education

National telephone survey of 2000 adults done in attempt to gain some measures of scientific literacy. **Page 37**

Technology

Energy policy experts fear that complacency due to the current oil glut will leave the U.S. unprepared for next energy crisis. **Page 39**

Preliminary Program

Highlights of ACS national meeting to be held in Anaheim in September include division symposia, preregistration coupon. **Page 43**

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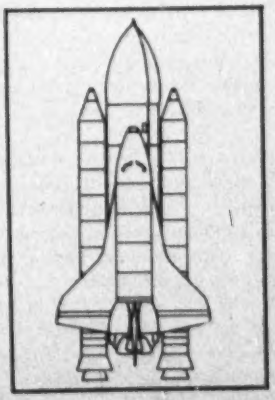

News Focus

One faulty joint on a solid booster rocket led to the death of seven crew members of space shuttle *Challenger* and to NASA's loss of face. Presidential commission investigating the accident recommends redesign of the joint or its seal, review of space agency's structure, and return to the "safety first" pledge. **Page 9**

Scientists Seek To Define, Determine Scientific Literacy

Consensus on meaning has been difficult, though survey makes an attempt at measuring general public's understanding

James H. Krieger, C&EN Washington

That the general public should have a greater degree of scientific and technological literacy is a proposition on which most members of the scientific community readily agree. Many recent studies of deficiencies in education, particularly in early science education, make just this point.

Defining the terms, however, is another matter. It isn't so easy to achieve a consensus on what really constitutes a scientifically or technologically literate individual.

"Scientific literacy is one of those terms that is more often used than defined," says Jon D. Miller, director of the Public Opinion Laboratory at Northern Illinois University. "The failure to examine and specify the meaning of scientific literacy has been the source of much of the confusion surrounding the issue."

Miller and a few other scientists took a stab at examining and specifying the meanings of scientific literacy during the recent annual meeting of the American Association for the Advancement of Science, held in Philadelphia. Noting that "there is more consensus on what constitutes scientific illiteracy than on what constitutes scientific literacy," Miller presented results of a survey that provide, as he put it, some new measures of scientific illiteracy. The analysis found a mixture of understanding and misunderstanding in the American public. But, Miller says, "It is bits and pieces without a theme."

Miller points out that literacy has two distinct and quite different meanings. The older meaning of the term refers to being learned. The second meaning refers to the ability of an individual to read and write at a functional level. He notes that the development of scientific literacy by a broader public did not become a subject of systematic study until the 1930s, when educators began to think about defining and measuring "scientific attitude." On the basis of that and later developments, he says, "The combination of two dimensions—an understanding of the norms of science and knowledge of major scientific constructs — may be viewed as the traditional meaning of scientific literacy as applied to broader populations."

F. James Rutherford, chief education officer for AAAS, thinks that "familiarity" with science is quite enough. Familiarity, he says, is a soft notion that he uses to make a distinction with educational terms like mastery learning, competence, or even the newer term literacy. He says he doesn't much like the term literacy, though he uses it, because of its bookish connotation and sense that what science is might be captured somehow by reading the right material.

"Whatever science is—and that's the starting place for figuring out what we want people to know—it's not a simple thing," Rutherford emphasizes. Science, he says, can be thought of as a body of ideas, as a way of thinking and investigating, and as something the products of which affect people's lives and determine how people live.

One of the aspects of science that people should have assimilated at the end of a process of learning, Rutherford says, is some sense of what the scientific world view is, that is to say, what the world looks like and seems like from the science viewpoint. And those aspects should be known in such a way that it is understood what a fact is, and, at a higher level, how facts relate to scientific laws and to other ideas. At a more general level still are the theories and models that organize facts, laws, and notions into larger areas such as gravitation, statistics, or weather systems, and, higher still, subjects like Newtonian universe, organic evolution, and plate tectonics. Another facet, moreover, is the set of beliefs shared by the people working in science—for example, that the world of phenomena is rationally understandable and not capricious, or that individual observations are subject to uncertainty but that the phenomena are consistent.

Among the aspects of science not understood, Rutherford says, is that it is not only personal. "It's not just Einstein out there thinking up things about the world," as he puts it. "It's a collective social activity. It's a collaborative activity."

In short, Rutherford says, "What I'm trying to indicate is that these aspects of the enterprise—that it's quantitative, it's qualitative, it's

Respondents report degree of comfort with terms

Term	Clear understanding	General sense	Little understanding
Molecule	32%	40%	28%
DNA	16	27	57
Radiation	31	51	19
Scientific study	33	50	17

large-scale, it's individual, it has values, it has an ethos, and so forth—need to be looked at."

Rutherford adds that the relationship between science and technology is perhaps as crucial as any other aspect. And it's not a simple relationship. They are different things, with different histories, different premises, and different purposes. And yet the overlap is large and increasing, and there is now an interdependency not only of technology on science but also the reverse. That, Rutherford says, ought to be part of the understanding.

Rustum Roy, director of the science, technology, and society program at Pennsylvania State University, agrees. Technological literacy, he says, is not merely analogous to scientific literacy. Roy quotes a writer as noting that there are two kinds of problems in life, one called convergent, the other divergent. Convergent problems can be solved, divergent problems simply can be addressed. Technological literacy, Roy says, is a divergent problem. It is one to be discussed, not solved.

Technological literacy is a complex, multidimensional reality, Roy notes. It means something different to different people. To Roy, it is equivalent to what he calls TC^3: comfort with, competence in, and control by a person of his or her life in the technological environment. Roy uses the metaphor of a tourist in a foreign country not knowing the language. One manages, he points out, but gives up autonomy and is usually led around by others. "The level to aim for," Roy says, "is to give people a Berlitz course in technology so they will have that level of functioning in the world in which they really live."

For the survey attempting to gain some measures of scientific literacy, the Public Opinion Laboratory collected data from a national telephone survey of 2000 adults. The interviews were conducted during last November and December. The survey was sponsored by a grant from the Science Indicators Unit of the National Science Foundation.

To gain an idea of people's ability to use some of the basic vocabulary of science, the survey included a series of items asking respondents to indicate their understanding of four terms: molecule, DNA, radiation, and scientific study. Miller says that other, earlier surveys using probes to explore the depth of understanding of selected terms found that about half of those people who report a clear understanding of a term are able to describe or define it adequately.

"It is clear," says Miller, "that a substantial majority of Americans do not have a sufficient vocabulary or comprehension of concepts to utilize a wide array of scientific communication. If a newspaper article or television report depends on some understanding of what a molecule is and how something might change it, at least two thirds of the American audience will have difficulty following the material."

A group of questions relating to astrology sought to examine the ability of people to distinguish between science and pseudo-science. A substantial minority of Americans appear to have some difficulty in making the distinction, Miller says. Two of five people give some credibility to astrology and 7% (which corresponds to about 12 million adults if extrapolated to the entire population) reported changing their actual behavior because of astrology reports.

Miller notes that another important dimension of scientific literacy concerns the knowledge and acceptance of some of the major scientific paradigms of the day. This area, he notes, is slightly more difficult because the spirit of scientific inquiry doesn't demand slavish adherence to every paradigm. At the same time, science does require the use of evidence in challenging a paradigm, and, Miller says, the typical nonscientist is ill-equipped to undertake that kind of dialogue.

So the survey included an area concerning basic theories and concepts. Miller notes that the degree of acceptance of certain scientific paradigms may be helpful in understanding the context in which scientific information is received and processed by the public. The survey, Miller says, found on examining people's views that they displayed a mixture of correct understanding and of basic misunderstanding. □

Statements gauge acceptance of scientific paradigms

Statement	Agree	Not sure	Disagree
Perceptions of the universe: "In the entire universe, it is likely that there are thousands of planets like our own on which life could have developed."	68%	9%	24%
Acceptance of plate tectonics: "The continents on which we live have been moving their location for millions of years and will continue to move in the future."	81	9	11
Acceptance of evolution: "Human beings as we know them today developed from earlier species of animals."	47	7	46
Belief in lucky numbers: "Some numbers are especially lucky for some people."	40	4	56
Rocket launchings and weather changes: "Rocket launchings and other space activities have caused changes in our weather."	41	12	47
Belief in extraterrestrial visitors: "It is likely that some of the unidentified flying objects that have been reported are really space vehicles from other civilizations."	43	11	46
Attitude toward planning for the future: "It is not wise to plan ahead because many things turn out to be a matter of good or bad luck anyway."	20	2	78
Attitude toward scientists: "Because of their knowledge, scientific researchers have a power that makes them dangerous."	53	4	44
Deference to experts and leaders: "In this complicated world of ours, the only way we can know what is going on is to rely on leaders and experts who can be trusted."	57	2	41

Older Chemists Continue To Be Targets in Mass Terminations

Michael Heylin, C&EN Washington

The serious impact of continued manpower cuts by chemical and oil companies on the chemical profession is confirmed by the latest American Chemical Society report on mass terminations of chemists and chemical engineers. The newest report, prepared by the society's Committee on Professional Relations (CPR), details investigation of 10 such terminations that occurred between June 1983 and April 1986 and cost the jobs of more than 200 chemical professionals. As has been the case in recent times, older chemists seem to have borne a heavy burden.

ACS guidelines

Advance notice. Four-week minimum.

Severance pay. Minimum is two weeks per year of service. Additional notice may be given, by mutual agreement, in lieu of severance pay.

Assistance. Efforts should be made to place terminee in another position within the organization, or terminee should be given assistance to find employment elsewhere.

Pension plan vesting. Full vesting after 10 years' service.

Employee service. Those with minimum of 10 years' service should not be terminated except for continued evidence of previously documented inadequate performance or cause.

Employee protection plans. Should be extended for a minimum of one month, plus two weeks for each year of employee service, following termination at same rate of contribution as before. Employee would have additional 31-day grace period.

Rehire privileges. Rehire privileges should be carefully explained to terminees.

Some of the bigger cutbacks reported involve research operations of petroleum concerns. The closing of the Gulf Research & Development Co. facility in Harmarville, Pa., after Gulf's merger with Chevron Oil cost the jobs of more than 70 chemists and chemical engineers. Another 35 chemical professionals lost their employment at Occidental Research Corp., Irvine, Calif., and 20 were involved in a cutback at the Texaco Research Center in Beacon, N.Y. The other seven terminations covered in the report involved 21 chemical professionals at Wright Chemical, 19 at U.S. Steel, 15 at Allied-Signal, 11 at Occidental Petroleum, seven at SmithKline Beckman, and three each at Stauffer Chemical and Penn Central.

CPR also has verified six other mass terminations and is investigating them. Those occurred between July 1984 and June 1986. They were at American Home Products, Atlantic Richfield, Betz Laboratories, Koppers, PPG Industries, and Uniroyal.

The committee defines a mass, or multiple, termination as "a situation in which the employment of three or more chemists or chemical engineers is terminated within a six-month period for reasons other than continuing evidence of previously documented inadequate performance, completion of a contract, or cause."

The latest report is the 23rd in a series produced by CPR since 1974. The reports compare the performance of employers involved in mass terminations with seven standards spelled out under ACS's Professional Employment Guidelines (PEG). Average compliance with those standards for the 10 terminations covered in the latest report is 43%—the same rate as for the 195 terminations analyzed in the previous 22 reports.

Those reports are all developed by CPR's Subcommittee on Professional Standards & Ethics, which in writing them seeks information both from the employers involved and from the terminees. About two thirds of employers respond with data. For the latest report, only two—SmithKline and Wright Chemical—did not.

For the latest report, CPR also received assistance from the Mid-Hudson, North Jersey, Orange County, Pittsburgh, Southeastern Tulsa, and Western New York local sections in gathering data from individual terminees. CPR also invites individuals either involved in, or aware of, mass terminations to contact the American Chemical Society, Office of Professional Relations, 1155—16th St., N.W., Washington, D.C. 20036; phone (202) 872-4431. That office also will provide, on request, copies of all CPR termination reports as well as a summary list of multiple terminations that have occurred within the past 10 years.

The seven PEG standards involved in those reports include length of employee service, rehire privileges, severance pay, advance notice, protection plans, assistance in finding other employment, and pension vesting.

The guideline on employee service states that those with a minimum of 10 years of service should not be terminated except for inadequate performance or cause. It has always been poorly complied with and compliance has deteriorated further in recent years. Such older employees were involved in all 10 of the terminations covered in the latest report. They also have been involved in all but five of the 47 ter-

minations analyzed by CPR since 1984. And of the grand total of 205 terminations examined by the committee since 1974, only 24% did not involve employees with 10 or more years of service.

Older employees were particularly hard hit at Texaco, where 14 of the 20 chemical professionals terminated had more than 10 years of service, and at U.S. Steel, where 12 of the 19 losing their jobs were in this senior category. According to data from terminees, the three chemists involuntarily retired by Stauffer were 55 years of age or older, as were the three chemical professionals similarly retired by Penn Central.

The guideline on rehire privilege has also been poorly complied with—only 16% of the time. It states, simply, that rehire privileges should be carefully explained to terminees. Only SmithKline met this guideline in the latest report. Several of the other employers apparently have some type of policy on rehiring. However, a majority of the terminees from the firms stated that those privileges were not explained to them.

The severance pay standard has always been a tough one for employers to meet. It calls for a minimum of two weeks' pay per year of service. It has been complied with only 17% of the time. But in the latest report, three of the 10 companies involved—Gulf Research & Development, SmithKline, and Texaco—met the standard. Gulf's policy provides two weeks' pay per year of service, with a minimum of three months' pay and a maximum of one year. Terminees from Texaco confirmed that the company provided one half-month's pay per year of service. And the majority of terminees from SmithKline reported receiving two or more weeks' pay per year of service.

In the latest report, six of the 10 employers met the standard for advance notice—sharply higher than the average 38% compliance of the previous reports. This guideline calls for a minimum of four weeks of notice. In three cases in the latest report, the standard was exceeded. Terminees received up to 11 weeks' notice at Allied-Signal, up to six weeks at U.S. Steel, and up to 14 weeks at Penn Central.

Employer compliance with ACS guidelines

These employers provided information	Approximate number of terminees	Advance notice	Severance pay	Assistance	Pension vesting	Employee service	Protection plans	Rehire privileges
Allied-Signal Corp., Buffalo Research Lab (Buffalo, N.Y.)[a, b]	15	□	☑	□	□	☑	☑	☑
Chevron Corp./Gulf Oil Corp., Gulf R&D Co. (Harmarville, Pa.)[b, c, d]	73	□	□	□	□	☑	☑	☑
Occidental Petroleum Corp., Cities Service Oil & Gas Corp. (Tulsa)[b, d, e]	11	□	☑	□	□	☑	□	☑
Occidental Petroleum Corp., Occidental Research Corp. (Irvine, Calif.)[a, d, e]	35	☑	☑	□	□	☑	☑	☑
Penn Central Corp., General Cable Corp. (Edison, N.J.)	3	□	☑	□	■	■	☑	☑
Stauffer Chemical Co., Peloer Labs (Houston)[b, c, d, f]	3	☑	☑	☑	■	■	☑	☑
Texaco Inc., Texaco Research Center (Beacon, N.Y.)[b, d]	20	□	□	□	□	■	□	☑
U.S. Steel Corp. Technical Center (Monroeville, Pa.)[b, e]	19	□	■	□	□	■	☑	☑

These employers provided no information; hence, all ratings based on terminee responses

SmithKline Beckman Corp., SmithKline & French Labs (Philadelphia)	7	☑	□	□	■	■	□	□
Wright Chemical Corp., Subsidiary of Portals Holding Ltd. (Schiller Park, Ill.)	21	■	☑	■	□	■	☑	☑

□ Employer met guideline standard.

☑ Employer did not fully meet guideline standard.

■ Employer was substantially below guideline standard, which is defined as follows:

- Advance notice—less than two weeks.
- Assistance—no assistance rendered.
- Severance pay—less than one week per year of service.
- Employee service—more than 40% of terminees had 10 or more years of service.
- Protection plans—no continuation of protection plans.

a Rating on advance notice based on information from the terminees. b Rating on rehire privileges based on information from the terminees. c Rating on employee service based on information from the terminees. d Rating on protection plans based on information from the terminees. e Rating on severance pay based on information from the terminees. f Rating on assistance based on information from the terminees.

The standard for employee protection plans states that such plans should be extended beyond termination by a minimum of one month plus two weeks for each year of employee service. It has been complied with about half the time. But in the recent report, only three of 10 employers—Occidental Petroleum, Texaco, and SmithKline—complied.

The standard on assistance states that efforts should be made to place terminees in other positions within an organization, or terminees should be given help in finding jobs elsewhere. It has generally been well complied with—more than two thirds of the time. And according to CPR, eight of the 10 companies either met or came close to this standard.

The standard most frequently complied with—84% of the time—is the one calling for full pension vesting after 10 years of service. SmithKline was the only company to fail to meet it in the latest report. Terminees from SmithKline report that pension rights are fully vested only after 15 years of service. □